

ADAPTING INSTRUCTION IN SCIENCE AND MATHEMATICS TO POST-WAR CONDITIONS AND NEEDS*

HARL R. DOUGLASS

University of Colorado, Boulder, Colorado

Any curriculum or course of study should be developed and continuously revised in the light of three major considerations:

(1) the nature of the group of learners for whom it is intended —their ability to learn, including their general capacity for learning, their background of information, concepts, and vocabulary for the particular field, and their skills in that field, their interests and their probable present and future needs.

(2) the conditions and trends of life which play a part in determining what our problems and educational needs are and are likely to be.

(3) current developments in the subject fields—new materials and changes in the relative importance of various materials.

Courses of study should always be in a state of growth and development so as to be kept in as close adjustment to changes in these three areas as possible. There will always be a lag, greater or less. Bertrand Russell, famous British philosopher and mathematician, once said, "The schools are driving the tacks where the carpet was last season."

We have been and are now living in a period in which unusually significant changes have been and are taking place in all three of these areas. The post-war world will be indeed, for those interested in the teaching of science and mathematics, one quite different in important respects from the pre-war world. In planning for teaching in the post-war period we are confronted with new conditions, with new developments, with changes in relative importance of many items of our subject matter, and with an increasingly challenging lag and increasing maladjustment of our courses of study. It is well that we seem to be in a frame of mind of taking stock and surveying with a view to revising our offerings.

THE POST-WAR STUDENT BODY

Beginning in 1945, we shall see within a few years the number

* An address before the Annual Convention of the Central Association of Science and Mathematics Teachers November 24, 1944 at the Stevens Hotel, Chicago.

of high school students shoot up past seven million and probably by 1950, approach eight million. Jobs will soon not be plentiful for people under eighteen or twenty, and millions of parents with more money than ever before will not only be able to finance secondary education for their offspring, but will be desirous of having them take advantage of the opportunity to better themselves and to contribute to the social prestige of the family.

We can confidently count on huge increases in college and junior college enrollments, not only of returned service men, but of young people of this new generation of well-to-do parents. At the University of Colorado this year the enrollment of freshman girls is a third greater than in the best pre-war year.

If and when a recession or a depression comes, as is more than likely, it will no doubt result in smaller enrollments in universities and four year colleges, but in high schools and junior colleges it is more than likely to contribute to even greater enrollments of young people, who, unable to obtain employment, will continue their schooling if it can be done without leaving home.

The presence of such large numbers of young people in school will constitute the resumption of a significant shift, under way for several decades previous to the war, in the composition and center of gravity of the young people in our classes. To some extent at least, they will be possessed of a lower average ability to comprehend and to retain. These newer recruits to secondary and higher education come disproportionately from the ranks of those of lower intelligence.

Of even greater importance, these new comers will without doubt, as was the case in the half century prior to 1940, be in the main characterized by a relative lack of interest in intellectual and bookish materials and activities and in forward looking preparation for later life. It is only to be expected that in periods of less universal attendance in schools, those of less academic interest, perhaps even more than those of less academic ability, tend to be among those leaving school early.

Thirdly, of very great importance to curriculum makers—and all teachers are more or less curriculum makers—their future needs will be significantly different from those of greater intelligence, intellectual interest, and character, inasmuch as they will for the great part gravitate towards the so-called lower vocational and economical levels, living under characteristic conditions of life and meeting problems characteristic of their

fellows. They will be compelled to do more of their own repair work and child care, and to spend their earnings more thrifitly.

In the fourth place the "other half" will come in disproportionate numbers from homes of less cultural atmosphere, of less well educated parents and homes in which there is less opportunity and stomach for learning. Consequently they come to our classes with an inferior background, lower morale, and inferior opportunities for home study.

Now all of these characteristics of the new high school and college student are meaningful for curriculum construction and revision. It is not wise, only impractical, to ignore these things, to fight rather than to adjust to these new conditions.

While the limitations of this paper do not permit a lengthy detailed analysis of all these matters, a number of the important implications of the nature of the post-war student body may be briefly enumerated. For them instruction must be less verbal, taught in connection with applications to situations arising in life, involving a smaller vocabulary load and should insure care in seeing that meanings of technical words are clearly comprehended. For them more attention must be given to surveying the background they bring to our classes in order that we may know upon how little we have to build.

The "other half" must be given instruction which will serve the future needs of men and women who will not go to college, may not complete high school—instruction which will serve the needs of youths who will go into the widest variety of less well paid occupations—factory hands, clerks, farmers, packing house employees, miners, truck drivers, cooks, bakers and waitresses, and scores of similar occupations. The greater majority of girls in the "other half" will be the wives of workers in these classifications. The curriculum maker-teacher must visualize the working and living conditions of these youngsters when they grow up and the educational needs indicated as a necessary first step in planning for their instructional needs. This fact seems all the more important in the light of the propensity of teachers with their limited out-of-school experience to think only of preparation for college and the professions, and for culture of a level assimilable only by those of greater intelligence and keener intellectual interests.

INCREASED IMPORTANCE OF PROBLEM OF MOTIVATION

The fact that those of the lower half are characteristically less

interested and "interestable" in verbal and academic materials and activities is further complicated by recent and current developments in the area of free and commercialized entertainment. Operating to distract young people and many of their elders, and to divert their attention to stimuli and experience more appealing than typical schoolroom activities, the opportunity for entertainment of great appeal has grown by leaps and bounds and is all the more formidable coming as it does along with the diminished and diminishing willingness to attend to the more difficult and less attractive, though more valuable, things in life. The movies wielded an influence distracting and dissatisfying enough in themselves, but today the radio brings at all times of day and night to the ears and imagination of practically all youngsters except in the poorest homes—thrills of adventure, excitement, prowess and humor which make exceedingly unsatisfying, if not indeed unpalatable, such things as exercises and problems in arithmetic and geometry and perhaps to a lesser extent the assigned lesson in biology and physics.

The returning service man will constitute a similar problem. Both his time and patience are likely to be short. He has experienced instruction of a type highly motivated, condensed, practical, concrete, involving realistic activity, aimed at objectives relatively obvious and important. He is almost certain to fret at covering grounds in books on little disconnected chunks principally for the purposes of recitation and examination.

WHAT CAN BE LEARNED FROM EDUCATION IN THE ARMED SERVICES

Maybe paradoxically, we can hope to learn not a great deal from instruction in the armed services and their schools which we can apply in high school and college. The situation is greatly and significantly different. The objectives are fundamentally different. Instructors in the armed services were concerned with a few specific things—not a broad education. In the most part theories and understandings were limited to those essential to doing a small number of certain and specific things. Learning was highly motivated—both by the natural situation and by rewards and punishments that are not available to us. Expense was no consideration. Classes were as small as need be and all the teaching paraphernalia asked for was obtained. Activities not books were to be learned.

Perhaps we can learn a few things from experience in the serv-

ice schools and camps. Among them may be the following:

1. To use more visual aids of all kinds.
2. To concentrate upon the more useful and valuable objectives and materials and upon appropriate mastery or growth, and to eliminate great masses of relatively less useful materials and details—long circuitous approaches.
3. To employ more doing, especially on the part of the less intelligent learners.
4. To take seriously the matter of instruction and to relegate secondary activities such as extra-curricular activities to a marginal place, or to re-organize them fundamentally so that they will contribute definitely and appropriately to the objectives of the school.
5. To focus upon learning progress, not upon teaching activities, traditional ceremonies or the prestige of the teacher as such.
6. To learn to select, organize and reorganize learning materials so as to contribute most effectively to the product sought and to clearly conceived objectives, rather than to focus upon causing pupils better to learn off static and pre-conceived bodies of subject matter—trusting that thereby the cause of education may somehow be served and condoning that easy approach by high-sounding, vague arguments and generalities which are not convincing as clean cut logic or reasoning.

PERTINENT POST-WAR CONDITIONS AND TRENDS

Now I must turn to what is perhaps the most important consideration of this paper—namely what will be the characteristics and activities of the post-war world which will be new or different and significant to instruction in science and mathematics. The following is an attempt to enumerate a number of them and to indicate briefly their respective significance:

1. First of all, though by no means most important, is the fact that in the post-war period we will rapidly become a world of air-transportation. While for at least a decade or so, we will have little need for more men in this country trained for flight and related ground work in addition to the hundreds of thousands we have trained in recent years, we will need to train a few young men and need to give training along lines of new developments yet to come. Rather, we will need to train the future general public to live in a world of air trans-

portation and to understand its significance for international relations. Not new courses will be needed to do this but many little adaptations here and there in our courses—particularly in problem material. Additional instruction about geography, meteorology and about instruments for measurement of a variety of things will be necessary as will of course calculations of distance, position, etc.

2. We will soon see new and more machines, in the home, on the farm, in the factory and in the business house. Few new principles will be involved but we will need to become familiar with many adaptations and applications. Every housewife and her "bitter" half will need to be to some extent an operator and repairman of a variety of machines and instruments—to know about their selection, installation, care and repair, and calculations involved.

3. The housing industry will boom for a decade or so, and a great variety of new developments which have been accumulating on blue prints will be put into practice involving knowledge relative to costs, financing, construction, decoration, new materials, storage and refrigeration and the like.

4. Women and Negroes will continue in industry and their education must be appropriate. The war has opened wide the door and they have made good. The clock will not turn back in this respect.

5. The problem of keeping the peace will be much in the foreground and important educational contributions by mathematics and science are vital. Future citizens for example must be conversant with the essentially equal biological, psychological, and cultural potentialities of all the various national and ethnic groups. Mutual respect and understanding are not only essential to plans of world organization and cooperation and peace, but if sufficiently developed, may actually make any especial organization for peace unnecessary. The war has placed an added burden upon us in this respect. In such times provincialism, K. K. Klanism, and delusions of superiority are generated, to say nothing of the propaganda of exaggeration and deception thought necessary to win the war relative to the characteristic cruelty and bestiality of our enemies—particularly in the indoctrination activities in the armed services.

6. Particularly of significance to mathematics teachers is the development of appropriate mathematical concepts in-

volving the general voter to understand the magnitude and implications of a \$300 billion dollar war debt—almost \$10,000 a family—certain to cost us in taxes if the government remains solvent, from \$300 to \$400 annually per family. Promise of one of the candidates for the presidency to extend social security and to reduce taxes at the same time were not convincing in terms of the pertinent arithmetic.

7. The impending threat of unemployment and depression also challenges the instructor in mathematics to tie up his subject with problems in that area—including purchasing power, public works, and the like.

8. We must give more attention to teaching about problems of conservation. We have been facing and will continue to face shortages in lumber and paper, coal and oil, and certain metals. The science of synthetics and other substitutes will be very useful in the post-war world.

9. As has been pointed out by many leaders in the teaching of science in recent years, science instruction is becoming as it should increasingly concerned with the social implications of new inventions, new medical knowledge and new scientific knowledge in general. Modern science teachers, for example, are more and more concerning themselves with what happens to patents to prevent them from being utilized so as to pass on to the masses the full potential benefits of the scientific genius, rather than to be bought up and shelved to protect existing vested interests or to be used for production on a basis of large profits per item on restricted production instead of small profits per item on large scale production. They are concerning themselves more with the relationship between science and invention on the one hand, and monopolies, cartels and tariffs on the other.

10. The development of subject matter in science and the fields of application of mathematics and science goes on apace. With the passing years American life is influenced by new products, new processes, new materials, whole new industries and resulting new social, civic and business practices and problems. Examples of this sort of thing are flying and the aircraft industries, synthetic rubber, fabricated housing, sulfa and other types of new drugs, the uses of molybdenum, and new knowledge about the mind, personality and mental hygiene. To these developments, instruction must be continuously adapted.

11. In recent years the development of commercial and political propaganda has skyrocketed in amount and effectiveness. With mass production and national and international markets, without excessive cost per item sold, huge sums of money have become available for bringing to play upon the potential purchaser pressure by the highest paid artists, musicians, entertainers, and writers. Likewise newspapers even throughout their news columns, periodicals, columnists and radio commentators particularly have become agencies of skillful and systematic propaganda.

The great increase in the pressures brought to bear upon all in American life today call for (a) a much better and broader basic knowledge in science and other subjects, (b) much more training in reading with scientific skepticism and efficient logical criticism and evaluation, and (c) objective skill and habits of reasoning and (d) contact with and practice upon in the school materials of propaganda in print and over the radio as is to be found in typical American life.

12. Along with the increased need for education and along new lines there has developed an intolerable overcrowding of the curriculum. As in one of the Aesop's fables—"all tracks lead in and none lead out." The resulting superficiality and ineffectiveness have increased to the point where several major operations must be performed. It is no longer a matter of what has or has not considerable value. The question now is, what is of highest value. In the interest of better education, students must study less and learn more.

The overcrowding of the curriculum in mathematics in grades 6, 7, and 8, resulting in part from the very wise postponement of difficult topics, which experience has taught us ruthlessly cannot be mastered in the lower grades, has reached the point where something serious must be done about it. Either the general mathematics of these years should be expanded into the 9th grade and algebra postponed a year, for which there is a preponderance of arguments, or drastic surgical operations of amputation. The same situation applies to our present day courses in physics and chemistry. Too much is attempted and too little learned.

We have obviously reached the point where no item of subject matter in high school or junior college science or mathematics can be retained unless it can justify itself clearly upon grounds other than its contribution to general discipline or

transfer of training, or because of its historical or traditional interest or importance. Competing items or units of subject matter with greater functional values also have disciplinary potentialities.

13. In the post-war period the trend toward increased attention to health will be accelerated—both physical and mental. More than twelve million men and women will have enjoyed health and dental service without cost—including millions who would otherwise have had only emergency service. Good physical condition will have been established in their minds as something to be maintained. Millions of service men and women will have been accustomed to a balanced diet who never before had known it. In addition millions of older civilians will have been able to pay for medical and dental service for the first time in their lives.

There will be a resulting increased consciousness of health—of health problems and of health information. Concomitantly great strides have been made in medical science and treatment.

As the result of the huge number of rejections and separation from service because of physical and mental condition, the attention of the general public, as during and after World War I, has been turned to the need for greater attention to health and physical education in the schools.

All these developments set the stage for increased attention to instruction in science topics related directly or indirectly to matters of individual and public health and sanitation.

14. Ideas and ideals of social security accelerate tremendously as the result of the depression and new deal measures have developed materially during these war years. Here as in England, plans for greater social security for civilians as well as for returned service men are now being devised to be soon put into operation. Unemployment prevention and insurance, public nursery schools, medical, nursing and hospital service, especially during maternity periods, child feeding, old age pensions and many similar ideas and plans for state and national governments to protect its people from fear and physical disabilities, will be much discussed and some actually put into operation. Materials and problems related to projects of these types, their costs and support will naturally be employed to greater extent than formerly.

CERTAIN IMPORTANT TRENDS AND SHIFTS IN EDUCATIONAL PHILOSOPHY

1. Greater Attention to Discipline in Education

During the war period there has been a very noticeable reactionary demand for a return to greater emphasis upon discipline. In war time our thinking naturally becomes colored with concepts of regimentation and obedience. "Theirs not to question why, theirs but to do and die." In the first year of the war, young men in training camps were put through the mill, given the works, and many were found unable to take it. Hospitals and sick bays quickly overflowed with victims of all sorts of physical and mental afflictions brought on principally by excessive fatigue and worry. Later the training processes were somewhat adapted to the nature of the human material, without serious loss of time. (As an aside, one may be excused for commenting at the much greater softness of the older civilians who belly-ached loudly and piteously because of the comparatively infinitesimally minor hardship of food and gasoline rationing and report filling.)

Nevertheless, the soft side of progressive education lost ground, though one may note that the soft side of training in the home actually grew softer as parents took advantage of the situation to saddle upon the schools more responsibility for the hardening of human steel through discipline and so absolve themselves more completely from responsibility.

As time went on, our thinking about discipline has matured. Our boys in uniform turned out to be not only sufficiently susceptible to discipline from without, but superior with respect to discipline from within, to resourcefulness and ingenuity, most desirable in these days of blitzkrieg, unconventional warfare in which decisions not only must be frequently made almost instantaneously in the light of developments which are not predictable but also often by small detachments and frequently by individual warriors. We began to realize more and more, that discipline of the highest sort was not merely responsiveness to command, but also self discipline, discipline from within.

In addition, we have come to realize that discipline for peace and discipline for war are not the same at all. The discipline of youngsters in school today must be for peace. Few of them will ever wear a uniform. They are either too young or too old—too

young for this war and let us hope too old for the next one. We are no longer satisfied with glittering generalities about discipline. We want to know what kind of discipline—discipline in what. There are thousands of disciplines—thousands of habits, ideals, attitudes, skills, and procedures which constitute disciplines and disciplinary products. We must identify those most needed in the post-war period and form our instruction in science and mathematics upon their attainment. Clear thinking about the disciplinary aims of education has long been overdue. Loose talk about discipline has been traditionally the haven of refuge of certain types of teachers where with lip service they could absolve themselves of their sins of sloth, vindictiveness, and thirst for personal power, and of responsibility for good cause of study selection, effective adaptation to the nature of learners, and for good teaching generally.

2. Trend towards Redistribution of Emphasis upon Types of Educational Objectives

In the post-war period certain trends toward redistribution of emphases upon various objectives of education are almost certain to continue. Among those likely to continue may be mentioned the following:

- a. Less emphases upon detailed information. We are more and more impressed with the illusory and ephemeral nature of items of information and experimental investigation has verified our casual observations. Detailed information will be more and more regarded as grist for a mill to turn out such things as general concepts and principles, attitudes, skills, ideals and interests—all more permanent and more widely applicable.
- b. A continued increase in emphasis upon teaching relationship—concomitance or correlation, cause and effect, applications and all sorts of inter-relations.
- c. A greater emphasis upon teaching for understanding—the uses, nature, meaning and fields of application of the important things taught. (The National Society for the Study of Education has a committee at work preparing a year book on The Measurement of Understanding.)
- d. Greater emphasis upon certain ideas and attitudes essential to international understanding and peace and to the continuation of our march towards the achievement of democracy in this country and elsewhere, e.g.,

1. Attitude of respect toward others of different nationality, color and language
 2. Attitude towards ideas—openmindedness, objectivity, etc.
 3. Attitude towards ethical standards—justice, fairness, honesty, etc.
 4. Attitudes towards procedures of clear thinking
 5. Ideals of peace and mutual international helpfulness
 6. Ideals of good living standards and security for all
- e. Greater recognition in practice of the precious nature of interests and potentiality for interests in the various fields of learning, thought and activity. The devastating extent destruction of the desire to learn more about science and scientific things by teachers in their awkward pressure brought upon students to get lessons and to prepare for examinations is becoming more and more obvious and more and more shocking. A trend, only a minor one until recently, but promising soon to become a major one, is that towards placing upon a pedestal among educational objectives that of building, expanding and directing interest of young people in all phases of science and scientific phenomenon rather than destroying it and building antagonism toward the study of science. Clear thinkers are realizing in rapidly increasing numbers that what we learn in school is not great, and that it tends to disappear and to grow out of date, and that a principal product of schooling is the ability and the desire to continue to learn about science years and decades after formal schooling has been discontinued.
- f. Closely allied, is the greater recognition of the importance of mental hygiene as applied to instructional methods and materials. Whatever may be said, truthfully or as the result of wistful thinking about the use of fear, threats, and intimidations as goads to get children to study, the quality of the result has not been high enough to offset the negative or harmful by-products in the form of unwholesome attitudes toward self, towards schools, and towards teachers and classmates.

3. Trends as to General Plan of Curriculum Organization

After years of discussion and experimentation with various plans for organizing curricula in areas broader and larger than

the single subject the more permanent trends seem now predictable.

- a. Further attempts at a unified curriculum including all or nearly all subjects will not be numerous and the idea will never become widespread. Previous attempts have not been regarded as very successful.
- b. The core curriculum, as made up combining several subject fields is also not likely to become more widespread except as in instances in which English and the social studies are combined.
- c. The tendency to correlate each field with others seems to be sound and will no doubt enjoy a slow healthy growth.
- d. The tendency to combine different areas within a broad field is here to stay, e.g., general science and general mathematics, instead of separate subjects in the junior high school. Experimentation in senior high school in both of these broad fields is in the cards, already under way in many schools, e.g., general physical science often including some geology and meteorology, and senior mathematics, including some each of algebra, geometry, trigonometry, and arithmetic.¹

It is even quite possible that we shall see more attention to biological science in the senior high school in the forms of a general science including general biology, bacteriology, human physiology, health, and related chemistry.

I think we can safely say that attempts to combine mathematics and science are likely to be less numerous than in the past. The trend is definitely not to slight the application of mathematics to business, consumer problems, civic matters, farm and shop in favor of the mathematics of physics, chemistry and engineering.

4. New Ideas about General Education, College Preparation and Vocational Education.

The trend of recent years towards general education is not likely to slacken. Attempts to provide curricula and to adapt courses in mathematics and other sciences to the special needs of special groups have not proven as practical as desired and anticipated. Curricula and courses built around the central theme

¹ See article by Blair in bibliography at end of this outline for brief descriptions of plans in 13 schools for teaching arithmetic in the senior high school courses in mathematics. See article by Hollinger and others describing general physical science course in Pittsburgh high schools.

and objective of general education have not only proven popular and practical, but there is much reason to believe that they serve very well the purposes of vocational and college preparatory education. By general education is meant instruction centered on the more common needs of the great majority of people—such areas as health, home problems, civic and character development, recreation, and general vocational intelligence as opposed to courses developed especially for small groups differentiated as to vocation or college going, e. g., science for auto mechanics, commercial arithmetic, the college preparatory curriculum, and the printing curriculum. As a consequence there seems well established a slow trend towards fewer specialized electives and greater adaptation within classes to variation in student interest and needs.

General education science and mathematics courses are including more and more materials of wide application to various types of vocations. This is as it should be. The place of specific vocational training is not secure. With changes in industry and commerce, a larger and larger majority of jobs call for little or no specific training that can not be gotten on the job. There are too many thousands of different occupations today for training to be devised for any considerable proportion of them. Greater and greater reliance will be placed on education for vocation in the general subjects, English, science, mathematics and the social studies.

With reference to college preparation, except for engineering and other technical schools and colleges, larger and larger becomes the question mark confronting the practice of attempting preparation by means of requiring certain subjects. Repeated investigations show that college grades are no more associated with the amount of work in so-called preparatory subjects than with the number of units in social studies and science, if intelligence is held constant. What is more, more recent informal investigations seem to confirm the growing body of testimony by college professors in all fields except physics that for the purposes of preparation for college, mastery of arithmetic and elementary algebra are more important than a half mastery of a larger amount of mathematics.

It is also becoming increasingly evident that it matters not so much what subjects are studied for preparation for college but how they are studied—the important things being a large and precise vocabulary, the ability to read understandingly to

organize ideas, and to see relationships, skill in problem procedures in all fields, and very important, an interest in intellectual matters and fields.

Trends in enrollments in recent decades have also served to lessen the importance of attempting to prepare for college. Such a small proportion of high school will ever go to college much less remain to graduate. Of 100 pupils in the seventh grade in North Central states, as for the U. S. as a whole, less than half will graduate from high school, slightly more than 1 in 10 ever enter college and only about 1 in 20 remain to graduate. Of a class of 35 to 40 seventh graders, only 4 on the average will enter college and only 2 become college graduates. Of a class of 30 to 35 ninth graders only about 6 will enter college and 3 remain to graduate. Of college seniors the expectancies are respectively not greater than 1 in 4 and 1 in 8.

WHAT A TEACHER!

All these trends call for a higher grade of teacher—a teacher more broadly informed and of broader interests in other fields and in the areas of application of his subjects. The day of the schoolmarm is just about over. One can no longer wisecrack that mathematics is a lazy man's subject. The situation is like that bemoaned by the fourth grader who complained bitterly that the teacher wasn't fair—"she changed the spelling words on him every day." The world does move. The teacher moves with it or becomes less and less effective, less and less worthy of a place in the driver's seat in the classroom. We teach not for the world of yesterday, nor the world of today but as best we can for the world of tomorrow.

The implications for continued self training and growth in service are somewhat staggering. As a matter of fact, when we left college our education was not only very fragmentary, but for the most part already partly out of date.

There is however a bright side. As never before, small readable reasonably reliable books appear in abundance bringing to us the more significant facts, trends and problems of the present and of the future, to say nothing of short non-technical pamphlets and bulletins in profusion on every subject and of readable articles in an ever growing number of semi-popular periodicals such as the *U. S. News*, *Science News Letter*, *Magazine Digest*, *Fortune*, *Time* and *Common Sense*.

If we want to get out of or keep out of the schoolmarm class,

there is no alternative. Time must be found to read even if we grade fewer papers and pass less time in interesting conversation. If we are to educate for the world in which our pupils will live our faces must be to the future and we must become acquainted with it as well as is permitted us.

Things are moving along so rapidly that we must find out what other schools and other teachers are doing and we must study and evaluate their courses carefully. We cannot afford to rely entirely upon our own resourcefulness. It is neither safe nor economical. I should like to close with a caution. Be slow to adopt what you do not understand clearly. The path of American education is strewn with the calamities of "experiments," the hasty attempts to put into practice ideas and procedures, of which teachers had only a very superficial understanding though the ideas for the most part were essentially sound. From this, God save us. It is least worthy of the exponents of science and mathematics.

SELECTED RELATED REFERENCES

- Benedict, Ruth and Weltfish, Gene. *Races of Mankind*, Public Affairs Pamphlets, No. 85, Public Affairs Committee Inc., 30 Rockefeller Plaza, N. Y., pp. 31, 10¢.
- Blair, Glen Myers, "Remedial Arithmetic in Senior High Schools." *The Mathematics Teacher*, XXXVI, December 1943. 346-350.
- Breslich, E. R. "The Place of Mathematics in Education for Social Change." *School Review*, XLIX, February, 1941. 104-113. Abstracts in *The Education Digest*, Vol. VI, April, 1941. 54-56.
- Brown, Wm. Adams, Jr. *The Future Economic Policy of the United States*, America Looks Ahead Series, No. 8, World Peace Foundation, Boston, 1943, pp. 15, 25¢.
- Cameron, Cornelia. "The Place of Geology in General Education." *The School Review*, LII, September, 1944. 427-430.
- Chase, Stuart. *Goals for America; The Road We Are Travelling*; and other monographs \$1.00 each. Twentieth Century Fund, N. Y.
- Davis, Ira C. "Trends in Science Teaching." *SCHOOL SCIENCE AND MATHEMATICS*, XLII, May 1942. 450-454.
- Douglass, Harl R. "Mathematics for All." *The Mathematics Teacher*, XXXV, May, 1942. 212-216.
- Dulles, Foster Rhea. *The Road To Teheran, The Story of Russia and America*, Princeton University Press, 1944, pp. 279, \$2.50.
- Guiler, W. S. and Hoffman, H. B. "Dividing Mathematics Time Between Arithmetic and Algebra." *The School Review*, LI, October, 1943. 471-475.
- Hanson, Alvin H. *After the War—Full Employment*, National Resources Planning Board, Revised, 1943, Superintendent of Documents, Washington, D. C., pp. 22, 5¢.
- Havighurst, Robert J. "Look Ahead in High School Science." *SCHOOL SCIENCE AND MATHEMATICS*, XLIV, February, 1944. 116-121.
- Hedrick, E. R. "Mathematics in the National Emergency." *The Mathematics Teacher*, XXXV, October, 1942. 253-259.
- Heidel, Robert H. "A Comparison of the Outcomes of Instruction of the Conventional High School Physics Course and the Generalized High

- School Senior Science Course." *Science Education*, Vol. 28, March, 1944. 88-89.
- Herriott, M. E. and Nettels, Charles H. "Functional Physical Science." *Curriculum Journal*, Vol. 13, 1942. 362-364.
- Hollinger, John A. and others. "Physical Science in Senior High Schools." *Science Education*, Vol. 28, April-May, 1944. 130-135.
- Hunter, George W. "Six Hundred Teachers Look at Science Trends." *Science Education*, Vol. 28, February, 1944. 15-25.
- Johnston, Eric. *America Unlimited*, New York, Doubleday Doran, 1944, \$2.50.
- Johnson, Palmer O., and others. "Symposium—How Can Science Education Make Its Greatest Contribution in the Post-War Period?" *Science Education*, Vol. 28, October, 1944. 231-238.
- Kaempfert, Waldemar. "Science, War, and Democracy." *Science Education*, Vol. 28, October, 1944. 199-208.
- Maverick, Maury, and others. *Century of the Common Man or Century of Cartel Control*, The People's Lobby, Washington, D. C., 1944, pp. 36, 10¢.
- Nathan, Robert. *Mobilizing For Abundance*, New York, Wittlesey House, pp. 228, \$2.50.
- Nelson, T. A., "The Future of High-School Chemistry." *The Journal of Chemical Education*, XVIII, March, 1941, 143-144. Abstract in *The Education Digest*, Vol. VI, May, 1941. 22-23.
- Novak, Benjamin J. "Needed Changes in Science in the Secondary School." *The School Review*, Vol. LI, March, 1943. 164-168.
- Persing, Ellis C. "Bringing Science Teaching Up to Date." *Science Education*, Vol. 28, April-May, 1944. 158-159.
- Potter, Mary A. "In Defense of Donald Dull." *The Mathematics Teacher*, Vol. XXXVII, May, 1944. 195-201.
- Reeve, William D. "Mathematics in an Air-Conditioned Civilization." *The Mathematics Teacher*, XXXV, March, 1942. Abstract in *The Education Digest*, Vol. VII, April, 1942. 42-43.
- Rogers, Mary. "Vitalizing Junior High School Mathematics for Non-College Students." *The Mathematics Teacher*, XXXV, December, 1942. 349-359.
- Schorling, Raleigh. "Trends in Junior High School Mathematics." *The Mathematics Teacher*, XXXV, December, 1942. 339-343.
- Shamhart, Ralph D. "Socializing Secondary School Mathematics." *The Mathematics Teacher*, XXXV, November, 1942. 321-324.
- Stewart, Maxwell. *Peace at Home and Abroad*, Harpers, N. Y., pp. 210, \$2.50.
- Welles, Sumner. *The Time for Decision*, N. Y. Harper Bros. pp. 431, \$3.00.
- Wright, William Albert Earl. "The Place of Industrial Chemistry in the Training of High School Chemistry Teachers." *SCHOOL SCIENCE AND MATHEMATICS*, XLIV, March, 1944. 257-259.

PROFESSOR E. H. TAYLOR RETIRES

Dr. E. H. Taylor, Head of the Department of Mathematics at the Eastern Illinois State Teachers College, has retired. Dr. Taylor has taught in this college since its opening in 1899. His many students and friends will be glad to know that he is in the best of health and plans to spend part of his time in revising his textbooks.